Irrigation as a Determinant of Social Capital in India: A Large-Scale Survey Analysis

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Abstract

Practicing agriculture requires organisation and coordination. To analyse the extent to which differences in agricultural practices can account for variation in social capital, a large survey containing indicators of social capital is combined with detailed agricultural statistics. The main factor under analysis is irrigation, together with prevalent grain sorts, thereby building on prior research. The richness of the datasets allows to explore various dimensions of social capital in geographic detail and their distribution among societal groups. Results reveal a significant negative influence of irrigation on the prevalence of conflict and an increased likelihood for communal conflict solution strategies within communities. These results are strongest for landholders working their own land, yet lose significance when accounting for intra-district correlation. For other indicators of social capital such as confidence and membership in organisations, the results are less conclusive, yet some interesting relations emerge.

Keywords: Determinants of Social Capital, Agricultural Organisation, Irrigation, Distribution of Social Capital

JEL classification: N55, O43, Q15, Z13

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1 Introduction

During the last three decades, economists' interest in the notion of social capital as a fundamental factor in economic production has risen steadily (Knack and Keefer (1997), Zak and Knack (2001), Guiso et al. (2004), Tabellini (2010)) and its influence on economic development is increasingly acknowledged (World Bank (2015)) At the same time, significant differences remain between countries and world regions regarding their measured social capital "stock", despite similar education and developmental achievements. The drivers of these variations are not yet fully understood. A number of works (Henrich (2004); Cohen et al. (1996); Alesina et al. (2011); Gneezy et al. (forthcoming)) have looked at the relation between our ancestral means of subsistence, e.g. farming practices and hunting organisation, and the way we structure our societies. Yet, irrigation as a fundamental characteristic of many agricultural societies has so far not received adequate attention from an econometric perspective, even though its importance has already been mentioned by Karl Marx (cited in Asche (1978)) and Wittfogel (1957). In the latter's notion of "hydraulic societies", it is the need to harness the power of water for purposes of irrigation or in defense of one's home area that made ancient societies, e.g. in the Middle East, develop elaborate administrative structures much earlier than societies living in geographically more advantaged world regions. More recent work by Talhelm et al. (2014) has focused on the prevalence of wheat vs. rice in cultivation, where the associated agricultural practices are thought to have a long-term impact on societal organisation.

The present study combines two datasets to add to this discussion for another world region, which is India. The wealth of agricultural and personal data allows it to separate the effects of grain sorts and irrigation on different indicators of social capital, both from a historic and current perspective. It finds only limited evidence for different types of grain cultivation as a crucial determinant, which might have to do with the fact that the lines between cultivation practices between rice and non-rice are not as clear cut as Talhelm et al. (2014) assumes them to be in China. Yet, it emerges that the share of irrigation has strong and consistent predictive power on some indicators of social capital, especially for those directly involved in the cultivation of their own land.

Various aspects of social capital, such as trust, network width or individualism/ collectivism, have been analysed to explain differences in economic indicators such as growth, saving behavior or prosperity (e.g. Gorodnichenko and Roland (2011), Knack and Keefer (1997), Greif (1993), Narayan and Pritchett (1999)). Often-cited definitions of social capital which also guide this present work come from Bourdieu (1986) and Putnam (1993), where social capital is defined as "the aggregate of the actual or potential ressources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" (Bourdieu). For Putnam, the essential aspects are "trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions". While the importance of these concepts is firmly established in the economic literature, its persistent differences between countries often remain unexplained. One prominent example is the socio-structural divide between countries of the "West" and those of the "Far East", where surveys of the former show substantially higher measures of "individualism" versus a higher degree of "collectivism" in the latter (Hofstede (2015)). For example, the six western countries of the G7 (USA, United Kingdom, France, Italy, Germany, Canada) all rank under the Top 17 of 69 countries for which data is available (average score 79 points on a 0-100 scale measuring individualism) whereas the main economies of the Far East (Japan, China, Taiwan, South Korea) all rank lower than number 31 and score a much lower 25 points on average. It is very interesting to note that this ranking seems to be not primarily determined by income, wealth or education of a particular country, with Japan and South Korea ranking far below much poorer nations such as Hungary or the Baltic States.

A recent study by Talhelm et al. (2014) makes a fundamental contribution in offering a history-based explanation for the roots of these persistent differences. In their study of Chinese students, those coming from areas with prevalent rice cultivation score significantly higher on measures of collectivism than those from neighboring (and therefore assumed as otherwise identical) districts characterised by wheat cultivation. The authors therefore conclude that the major importance of rice cultivation in East Asia versus wheat cultivation in countries of the West is one fundamental reason for persistent observable differences between these two world regions. More specifically, the authors hypothesize that the specific demands of rice in cultivation (labor intensity and irrigation requirements) necessitate rice-growing societies to act in a more coordinated and communal way than the comparative independence of wheat cultivation.

In its basic argument, that the organisation of food production as the central occupation for the majority of people until comparatively recently shaped societal behavior and organisational forms, the present study follows other scholars that have explored this nexus. Notable examples include Henrich et al. (2001)'s study of fifteen indogenous societies, which shows that the degree of cooperation required between individuals during food acquisition is related to cooperation in experimental settings. A study with a related approach comes from Gneezy et al. (forthcoming) who explore variations in cooperative behavior in experiments with Brazilian fishermen, with one group fishing either at sea and another individually at a nearby lake. Through a series of economic games, they find a strictly higher willingness to cooperate among sea-fishers. There are also examples of social norm generation and transmission from agricultural factors: a study from Cohen et al. (1996) relates today's aggressive potentials of southerners in the USA to the cultural heritage of British pastoralists who first settled today's southern USA and were used to having to defend their territory, wheras northerners trace their roots more frequently back to British farmers, bringing with them a culture of cooperation and coordination. These results are confirmed by Grosjean (2014), specifically in areas where historical institutional quality was low. Alesina et al. (2011) find a correlation between today's role of women in society and the historical onset of plough usage, thereby building on a hypothesis from Boserup (1989), where physical exortion and lack of opportunity for taking breaks when working with the plough prevented shared work on the field. A theory related especially to the second hypothesis comes from Wittfogel (1957), whose term "hydraulic societies" implies the central role of water harnessing in fostering a strong and effective state. Early civilizations, such as the Egyptians, Babylonians or the Indus valley culture therefore profited from their centralized structures, which in turn were a result of the need to coordinate in water management. Regarding rice cultivation and associated irrigation, besides the mentioned study by Talhelm et al. (2014), one relevant work for this analysis comes from Tsusaka et al. (2015, in press). By combining survey, experimental and econometric data, the authors show that the adoption of altruistic and cooperative behaviors is higher among farmers practicing irrigation vis-à-vis rain-fed agriculture. For cooperative behavior, the neighborhood effect is stronger among farm plot neighbors than among residential neighbors, providing evidence for the binding effect of common labor in the field.

By combining two publicly available datasets, this present study correlates information on indicators of social capital at the household level with agricultural statistics at the district level to inform the debate on determinants of social capital. The depth of the data allows the separation between effects of crop choice, cultivation technique and individuals' roles in the agricultural production. In trying to capture historic agricultural patterns, the earliest available comprehensive data is used. Fortunately, these series were initiated before or at least only during the early phases of the "Green Revolution" in India. Furthermore, different aspects of social capital i.e. confidence and membership in organisations can be analysed separately with the data at hand, together with conflict and related solving strategies at the village level. The case of India is important in this debate as it not only geographically, but arguably also socially lies between the Western and Eastern hemisphere (Rank 29 in Hofstede-ranking, average individualism score of 48) and its environment fostered the cultivation of various crops with differing methods, so that specific effects of grain sort and cultivation method can be isolated. The relevance of this study can be understood when looking at recent large government initiatives like the one labelled "Rurban" , which, in boosting rural infrastructure and services towards urban levels, might be facing very different social structures depending on what agricultural practices prevail in different areas (Deccan Chronicle (June 12, 2014), The Times of India (June 10, 2014)). The same holds true for a proposed push in irrigation development (The Hindu (August 20th, 2014)). In the following, Section 2 gives an overview on characteristics of grain cultivation in India and associated practices. Section 3 states the main hypothesis, describes the dataset and introduces the econometric model. Section 4 presents the results of various regressions, before Section 5 discusses these results and concludes.

2 Grain Cultivation in India

Cultivation of grains in India varies widely with the prevailing environmental conditions.[1] The main sorts in 1977[2] included rice (36% of total grain cultivation area), sorghum and millet (30,2%) and wheat (18,2%). Areas of rice cultivation are to be found mainly along the coasts and the lower Ganges river, whereas wheat sorghum and millet are cultivated in the drier and cooler areas of the Deccan Plateau, the upper Gangetic plains and the Punjab. It is worth noting though that there are also areas, where both rice and other grains are cultivated side by side, such as the Gangetic plains (for detailed maps, see Annex, Figures 5-5). Another important observation for this study is that a large share of rice cultivation (64% across India in 1971) takes place without irrigation. In these cases, rice may be cultivated either relying on inundation through natural sources, or in dry cultivation. This holds especially true for those areas receiving relatively reliable rainfall along the Western Coast and in the Gangetic plains. For wheat, the observation might be surprising that a significant share (56%) of area under cultivation is irrigated, especially in the Punjab and along the upper Ganges. These observations question the view at the base of Talhelm et al. (2014)'s hypothesizing that rice cultivation is exclusively characterized by irrigation, whereas wheat cultivation is a matter of mostly sowing and harvesting. Especially in areas of rice cultivation under dry conditions, the step of seedling transplantation, which is crucial in irrigated fields and leads to acute peaks in labor demand, would be absent, since rice seeds are thrown on the field just as they are in wheat cultivation. This is the other feature of rice cultivation underlying Talhelm et al. (2014)'s reasoning, that rice carries with it a higher demand of labor apart from irrigation works that is not to be found in wheat cultivation. An impression is given by the required weekly working days for the cultivation of 1ha of rice in a non-mechanized agriculture under irrigation techniques. It is evident that to some extent the preparatory, but mainly the transplantation and harvesting periods require more work than the family household can manage, especially when considering an average of 1.21ha/ holding (excluding holdings larger than 10ha) from 1970 for Bihar, a rice-producing state (ICRISAT (2013)). Until today, only a minority of rice fields exceed 1.5ha (Agriculture Census of India (2015)), with a mean size of 1,1ha (again excluding the largest estates), which is minuscule compared to the largest corn or wheat plantations in industrialized countries. This lack of industrialization and mechanisation is mainly caused by the composition of soils and the location of rice fields along terraced terrain (Bray (1994); Grist (1975)). Therefore, the absence of economies of scale contributes to a continuous labor-intensive agriculture in many rice growing countries, and also prevents a rural exodus and alteration of rural lifestyles as observed in many western countries.

In this light, it is not surprising that a number of labor sharing institutions have been devised by rice cultivators in Asia, in order to cope with the high labor demand over short periods. These include wage labor of lower for higher castes in India (a system that is said to stem in places from the first century

[1] Note: Most agronomic information in the following was taken from a publication by Rehm (1989). If other sources are used, these are stated explicitly.

[2] Newer data are of course available, yet the earliest available comprehensive statistics will be used in the following, accounting for the long-term manifestation of social behavior and avoiding possible recent shifts in cultivation patterns.

Table 1: labor required for cultivation of 1ha of rice

Procedure	Period (weeks)	Working Days/Week(approx.)
Land preparation & set-up of seedling beds	5-6	7-14
Transplanting of seedlings	1,5-2	10-20
Weeding	5-7	3-8
Caretaking	13-15	0,7-1,5
Harvesting, Threshing, Cleaning, Storing	2	20-30
Total	26,5-32	4-8

Source: taken and adapted from Rehm (1989)

AD (Bohle (1981))) but also labor exchanges as have been documented in China (Bray (1994)), Malaysia (Wong (1987)) and the Philippines (Sajor (2004)). These systems help to coordinate the labor in a given geographical entity (often simply the village) during peak demand times by staggering plantation dates and a reciprocity-based scheme, where all farmers help to finish one field, before all farmers work on another field they do not necessarily own without any kind of payment. There seems to be a relative scarcity of evidence for these labor exchanges in India, potentially because labor allocation is rather caste-based and thereby not entirely voluntarily and cooperatively organised (Nakamura (1972)). An interesting exception is to be found in the Tamil word "kaimath" (literally "hand exchange") that is used both for work in a labor exchange system but also the lending of money without asking for interest. Generally though, it could be the case that communal organisations for rice cultivation are much less prevalent in India than in countries further east, since cultivation techniques and societal organisation differ substantially. It has to be noted that labor exchanges were replaced by wage-based systems in many Asian countries over the 20th century, mainly due to high population growth (Rao (1999)).

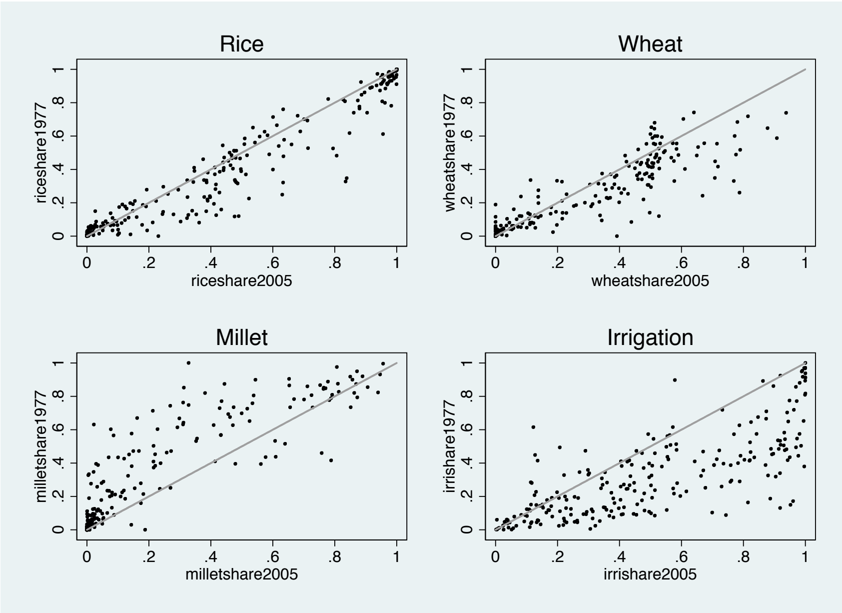
For sorghum and millet, many characteristics of cultivation are similar, so they will not be described separately. In India, they are often cultivated side-by-side with vegetables or other cash crops and only very rarely in irrigated systems. Traditionally, the seed is thrown or placed in rows in the soil of the drier and cooler areas. These lie mainly in the Deccan Plateau of central southern India and the dry areas of the West (see maps in Annex for details).

Wheat traditionally occupied around one fifth of the area under grain cultivation. Often, it is grown over the winter, while the same fields are used for cash crops such as sugar cane or cotton during other periods. There are also a number of areas where rice and wheat are grown interchangeably, or where wheat is sown into irrigated furrows in vegetable fields. In 1996, such areas accounted for around a third of all wheat cultivation in South Asia, of which again three quarters are grown under irrigation (Sayre (2002)) Irrigated wheat fields can be found along the Himalaya and in the very dry areas of the west, whereas unirrigated wheat is grown in central India.

The use of early accounts of agricultural production in the latter analysis is justified when looking at Figure 1. A large number of districts have altered their patterns of grain cultivation considerably over the last 40 years, as indicated by their position relative to the line. Notably, irrigation has increased in a lot of districts. Probably linked to this is a shift in the grain sorts under cultivation, where rice and most noticeably wheat increase at the cost of millet.

As already alluded to above, not only rice is grown under irrigation in India, but also wheat and other grains. It is perhaps surprising to note that in 1977, i.e. already before the big increase in area under irrigation, (only) 36% of rice fields were under irrigation, whereas 63% of wheat fields received water artificially. Millet is very rarely grown under irrigation (only 4% of acreage irrigated, Agriculture Census of India (2015)). Statistics do not include accounts of the amounts of water used in irrigation. Yet, one can assume that any kind of irrigation, whatever its size, demands coordination, possible even

Figure 1: Shares of grain sorts & irrigation within districts (1977-2005)



with decreasing demands for bigger structures. Therefore, the actual amount of water used is only of secondary importance.

There are a number of descriptive studies on historic irrigational practices in the case of India. Raghuvanshi (1995) describes the development of regional irrigation projects, complementing local microstructures starting already under colonial rule, which share water from where it is abundant with undersupplied areas. In these, local distribution is still mostly organized by local groups. In northern India, this system is called "warabandi", which can be translated as "strict order" (after Bandaragoda and ur Rehman (1995)). This entails an allocation of water to the farmer according to his field size, which in turn determines the crop rotation of the farmer. An example for another system is the allocation of water rights to all residents of a particular area by a third party, after which landless peasants can sell their water rights. Bandaragoda and ur Rehman (1995) also state that the warabandi system was already in place long before its institutionalisation by the British colonizers, and might in fact even date back to the early Indus valley cultures. For southern India, Bardhan (2000) in his field study of 48 irrigation communities finds an even share between the adoption of public systems and the renitence of traditional ones, depending on the degree of water scarcity and duration of existence. In the traditional systems, he reports that those with frequent meetings are characterized by less conflict. Coordination of labor and work on the shared irrigation structures is coordinated centrally by a village assembly.

To sum up, there is a high variety of grain cultivation in India, and a non-monotonous relationship of grain sort cultivated and irrigation.

3 Hypothesis, Data and Model

3.1 Hypothesis

As evident from the discussion of agricultural structures above, the clear distinction between rice farming, characterized by periods of high labor demand and irrigation, and wheat farming, with low labor demands and no irrigation, on which Talhelm et al. (2014) base their argument, cannot be made for India. Firstly, wheat is actually grown more under irrigation than rice. Secondly, the high labor demands of rice are only relevant when it is grown under irrigation, as it is only then that seedlings have to be planted in a short period of time. Yet, when rice seeds are sown into the field directly as it is under non-irrigated cultivation that relies solely on rainfall (and not on inundation, where the case might be different again), there is no reason why this should entail a higher labor requirement than wheat cultivation. Therefore, it might be that the effect for rice that Talhelm et al. (2014) see in China is largely driven by the irrigation that is clearly associated with rice cultivation there, whereas labor exchange plays a smaller role. For India, the data does not allow to separate between areas where rice is grown under irrigation, natural inundation or on dry fields, which would allow to test for a specific effect of labor exchange practices. Yet, if we find a positive effect of irrigation on social capital regardless of the grain that is cultivated, this should hint at an impact of the organisation surrounding irrigation, and not so much of the grain that is cultivated. To test the hypothesis that the high labor demand of rice fosters cooperation, we can still compare the impact of different grain sorts, assuming that at least in some areas rice cultivation implies labor coordination, and more so than the cultivation of other sorts. The main hypothesis to be tested below is therefore:

H1: Irrigation should be fostering cooperation and trust, since the sharing and maintenance of channels and other structures requires coordination and shared organisation.

This hypothesis is in its kind related to the other studies of a long-term societal impact of agriculture mentioned in the introduction.

In addition to the regressions for the overall sample and in order to shed light on the question of norm transmission and persistence, it will also be examined whether effects differ between those cultivating their own holdings (land-holding agriculturalists"), those holding land without cultivating it ("land-holding non-agriculturalists") and those cultivating the land of others ("landless agriculturalists"). Following the above reasoning, we would expect to see the strongest effect of irrigation for those working their own land, with lesser effects (potentially through spillovers) for those with different occupations from the same area.

H2: Irrigation should have the strongest effect on indicators of social capital for those directly engaged in cultivating their own fields.

Furthermore, the data can provide some insights whether rice itself has a positive effect on social capital through its related labor organisation. Yet, the caveats associated with this hypothesis demand a very careful interpretation of the results for these estimates.

3.2 Data

To perform this analysis, two publicly available datasets are combined. The first, the India Household Development Survey (hereafter IHDS, Desai et al. (2009)) has been compiled in the years 2004-2005 for a representative sample of more than 40000 Indian households, asking them about a broad array of aspects of their daily life. This dataset has been used widely by researchers such as Bros and Borooah (2013), Vikram et al. (2012), Story (2014) and Vanneman et al. (2006) where the latter work is in its research interest related to this present analysis. The authors find that indicators of social capital vary widely across India, and show that different measures are often not correlated among each other.

Within this study, out of the 945 variables, the ones concerning membership in organisations, conflicts and their solution within the community and confidence in institutions are the most important and will be used as indicators for social capital. The number of observations is slightly reduced from the overall sample of 41554, owing to a lack of agricultural data for some minor states and territories (including Jammu & Kashmir, Delhi, most north-eastern states and union territories), the exclusion of residents of the six major metropolitan areas (Mumbai, Delhi, Bangalore, Chennai, Hyderabad, Kolkata), those who have not lived more than 10 years in one place (2579 obs. of the remainder) and those where relevant information on indicators of social capital is missing (18 obs). The decision to leave out recent movers was based on the assumption that people are influenced by the social norms of the area where they and their parents come from and this relationship may be less evident with people who have recently moved to other places. Since this is especially true for the big metropolises where agriculture has long since ceased to play a role, these are excluded from the following analysis. The resulting sample size, for which answers for at least one indicator of social capital were available is 32524 households, with an average household size of 5,3 individuals. Since a number of questions on indicators of social capital, such as whether any household member is in a specific association, are based on all household members, the effective size of the sample increases for these questions.

To separate the sample into agriculturalists and non-agriculturalists, the question regarding the main source of income for the household was used. Here, the former are defined as those households where cultivation, allied agriculture or agricultural labor were stated as the main sources of income. Non-agriculturalists mostly comprise non-agricultural labor, salaried jobs, artisans and other minor groups. Similarly, a direct question on land holdings of the household was used to differentiate between landowners and the landless. The two dummies are combined to differentiate between landless and land-holding agriculturalists and non-agriculturalists. Their respective shares are presented in Table 2.

Table 2: Numbers and Shares of Agriculturalists and Landowners

	land=0	land=1	Total
agric=0	13333 (41%)	4699 (14%)	18032 (55%)
agric=1	3530 (11%)	10962 (34%)	14492 (45%)
Total	16863 (52%)	15661 (48%)	32524 (100%)

The richness of the dataset also provides a number of control variables which are included (but not always reported) in the regressions below. On the household level, these include (the log of) stated household income, caste status, average years of education of the oldest male and the oldest female in the household and the type of residence (rural, urban, urban slum). Following Mauro (1995), ethnolinguistic fractionalization is controlled for through a measure of the likelihood that two people from the same principal sampling unit, the village or neighborhood, share the same language and religion. Neither religion nor language by itself might be a suitable measure for ethinc group in India, where religious groups transcend language borders and vice versa, which is why the two are combined. Further controls on the district level are derived from statistics of the 2011 Census of India (Government of India (2011)). These include the share of population for each of the main religions in India (Hinduism, Islam, Christian, Sikhism, Buddhism, Jainism), the urbanisation rate and the share of illiterates.

The second dataset with the main explanatory variables is provided by the International Crops Research Institute for the Semi-Arid Tropics (hereafter ICRISAT; ICRISAT (2013)). In its "Village Dynamics in South Asia" database (hereafter VDSA), yearly agricultural statistics based on official records are compiled for most Indian states on the district level, dating back as far as 1966. Detailed data on the gross area under irrigation is used to determine the share of land in gross cultivated area. Furthermore, dummies were generated for each district that equal one when the share of the four main sorts in cultivation (rice, wheat, millet, maize) exceeds one third of total grain cultivation. The decision was taken not to use a continuous share variable for each sort, as for example the share of rice does not say anything about whether the rest of the area is cultivated with wheat or millet, which might come with different cultivation practices. Therefore, these dummies measure the prevalence of a particular grain in a given district. Throughout this study, only the relative importance grain cultivation within all grain cultivation is measured, whereas other crops such as cotton, sugar or vegetables are excluded. This might in some cases largely overestimate the actual share of grains in all cultivation, yet takes into account the assumed central role of grain cultivation and its probable predominance until not long ago.

Overall, the IHDS includes, after all stated exclusions, observations for 326 districts. These are matched with information from the VDSA data. One point worth mentioning is that the VDSA is compiled based on the district boundaries of 1966, in order to ensure comparability over time. In order not to lose out on the districts separated from others after this date, it is assumed that the new districts have the same agricultural features as their mother districts. In cases where one district has two (11 cases) or three (one case) mother districts, the average of agricultural features of mother district was assumed for the new ones. Reapportioning was done based on a publication by VDSA (Rao et al. (2012)).

One drawback of the Indian case as compared with the Chinese sample of Talhelm et al. (2014) is its possibly higher ethnical heterogeneity. While Talhelm and his co-authors recruit students from a narrowly defined geographical area with a shared language, ethnicity and cultural heritage, the present sample covers 19 federal states, 12 official languages and various cultural groups. To account for this fact, all regressions are run with state-fixed effects, thereby exploiting only within-state variation. The range of districts per state ranges from 3 (Uttaranchal, 325 observations) to 31 (Uttar Pradesh, 3139 obs.) At least in southern and eastern India, where state borders are mostly drawn along language and ethnic borders, this should rule out a number of problems related to omitted variables.

Following the concept of long-term manifestation of social norms, the earliest available comprehensive accounts are used. In the VDSA data, these come from the year 1977.[3] This date might not be as early as one could wish for as it might not be reflecting earlier patterns of irrigation, yet as is evident from data of the Agriculture Census of India (2015), the big push in infrastructural development of irrigation structures in India only gathered momentum after 1977[4].

Out of the wealth of the IHDS survey, six measures for social capital are derived, which are in line with different dimensions of social capital as mentioned above. Details on the design of the indicators can be found in 7 in the Annex. The first, hereafter the "Conflict Solution" indicator uses the results to a question on whether water supply problems in a community are solved by each family individually (=0) or bond together (=1). The answers are pooled at the village-/ neighborhood level as the principal sampling unit, since the question does not relate to one's own problem resolution strategy, but to that of the community. Secondly, the "Level of Conflict" indicator is based on the answers to a question regarding the overall level of conflict in the village or neighborhood on a scale from 1 to 3, where 1 denotes high levels of conflict. Again, answers are pooled at the PSU-level. The third, hereafter the "Local Confidence" indicator states the individual confidence in a local institution, i.e. the local assembly ("panchayat, nagarpalika"), again on a scale from 1 to 3, where 1 denotes low confidence. Among the set of questions in the IHDS, this one is singled out, as there is a direct link between local organisation and the above hypotheses on an effect of irrigation on local organisation. A more general indicator regarding confidence ("General Confidence" indicator) is an index based on a number of questions eliciting confidence towards different public and private instiutions. This index is predicted via the average z-score of the answers. In addition and following one of the main strands of literature on social capital, membership in organisations is looked at in the "Local Membership" indicator. This equals one if any member of the household is member in at least one of four community-based organisations. Finally, the attendance of a public meeting by any of the household members is examined in the "Attend Public Meeting" indicator. In all specifications, the higher value for the dependent variable indicates a "higher amount" of social capital. In this way, interpretation of positive or negative coefficients can be done intuitively.

[3]Data for 1977 was not available for the state of Assam, where the series started only in 2006. Therefore, the data for 1977 was taken from that year.

[4]18% of total area under cultivation irrigated in 1970-71; 19% in 1976-77; 25% in 1985-86; 44% in 1996-97; 47% in 2005-06)

3.3 Model

The basic model with fixed effects estimated in the below regressions therefore takes the form

$$SC_i = \beta_0 + \alpha_j + \beta_1 irrigation_k + \beta_2 D_k + \beta_3 ELF_l + \beta_4 X_i + \beta_5 Z_k + \varepsilon_i$$

where i={32524 households}, j={19 federal states}, k= {326 districts} and l={2078 PSUs}. SC denotes the dependent indicator of social capital, α_j the state fixed-effect β_1 and β_2 the coefficients of interest, D_k the set of dummies for the main sorts of grain cultivated, $\beta_3 ELF_l$ the measure of ethnolinguistic fractionalization within the PSU, $\beta_4 X$ a matrix of control variables on the household level with the respective coefficients, $\beta_5 Z$ a matrix of control variables on the district level with the respective coefficients and ε_i the robust error term. Depending on the coding of the dependent variable, OLS or logit-regression models are used. In additional regressions shown below, the standard errors are clustered on the district level to account for intra-district correlation.

Descriptive statistics for dependent and explanatory variables can be found in Table 5 in the Annex. It is evident that the indicators for social capital vary quite strongly between agriculturalists and non-agriculturalists for some indicators. Furthermore, the sample is nicely split between these two groups, and all indicators present relatively high variance.

4 Results

In the following three tables, the results for the six selected indicators are shown. All regressions are estimated with fixed effects at the state level. In all cases a first specification looks at the relevant effects for the whole sample, whereas the second specification differentiates between landless laborers, landholding non-agriculturalists, and farmers on their own land, and the respective influence of irrigation. The third specification replicates the second but uses standard errors clustered at the district level. When the answers are coded 0 or 1 (i.e. for the "Local Membership" and the "Attend Public Meeting" indicators) the logit model is specified as described above, whereas for the continous or pooled answers a standard OLS model is applied. Since the primary goal of this analysis is not to quantify effects of compare them between indicators (which would make little sense with answers that are rather subjective), these two different specifications should be no further cause for concern. It is worth noting for the dummies that the reference category is maize cultivation in all specifications. As this grain is relatively unimportant, it suffices to compare the coefficients of the three main grain sorts.

For the level of conflict in Table 3, the analysis in columns (1) and (2) reveals a picture in support of H1 on the influence of irrigation on social capital. The irrigation variable has a significantly positive effect in the first specification, indicating a lower prevalence of conflict in communities where irrigation is important. Here, rice cultivation is associated with a relatively low conflict prevalence, compared to the other main grain sorts, especially wheat. When looking at different sub-groups, there is no evidence in support of H2 for differential effects of irrigation among them. Regarding the other controls, income and ELF display the expected signs, whereas education has no influence on the indicator. Since an average of 15.6 (sd=6.5) people were interviewed per sampled neighborhood or village, a representative impression of conflict within the given community can be assumed. When accounting for intra-district correlation in (3), the results change though. None of the main explanatory variables has a significant explanatory power anymore, hinting at a high correlation of answers within districts. It is worth noting though that the influence of irrigation is close to a significance level of 10%.

For the solution of local conflicts in Table 3, columns (4)-(6), the results reveal a strong and precisely estimated positive effect for irrigation in line with H1. The more irrigation is practised, the higher the

Table 3: Level of Conflict & Conflict Solution

	Level of Conflict			Conflict Solution		
	(1)	(2)	(3)	(4)	(5)	(6)
irrigation	0.351	0.328	0.328	0.044	0.145	0.145
	(0.023)***	(0.027)***	(0.214)	(0.015)***	(0.017)***	(0.123)
d.rice	-0.056	-0.057	-0.057	-0.031	-0.030	-0.030
	(0.022)**	(0.022)**	(0.180)	(0.011)***	(0.011)***	(0.077)
d.wheat	0.148	0.149	0.149	0.084	0.085	0.085
	(0.020)***	(0.020)***	(0.158)	(0.009)***	(0.009)***	(0.062)
d.millet	-0.067	-0.067	-0.067	0.030	0.033	0.033
	(0.023)***	(0.023)***	(0.188)	(0.010)***	(0.010)***	(0.064)
income	0.006	0.006	0.006	-0.002	-0.002	-0.002
	(0.002)***	(0.002)***	(0.003)*	(0.001)**	(0.001)**	(0.002)
education	0.001	0.001	0.001	0.001	0.000	0.000
	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)	(0.001)
ELF	-0.050	-0.053	-0.053	0.008	0.009	0.009
	(0.016)***	(0.016)***	(0.085)	(0.010)	(0.010)	(0.047)
irri*agric		0.017	0.017		-0.219	-0.219
		(0.035)	(0.105)		(0.024)***	(0.082)***
agric		0.004	0.004		0.025	0.025
		(0.015)	(0.040)		(0.010)***	(0.027)
irri*land		0.059	0.059		-0.175	-0.175
		(0.043)	(0.135)		(0.026)***	(0.074)**
land		-0.033	-0.033		0.050	0.050
		(0.014)**	(0.045)		(0.008)***	(0.024)**
irri*agric*land		-0.039	-0.039		0.258	0.258
		(0.057)	(0.125)		(0.036)***	(0.076)***
agric*land		0.002	0.002		-0.055	-0.055
		(0.020)	(0.043)		(0.012)***	(0.026)**
R2	0.24	0.24	0.24	0.20	0.21	0.21
N	32,490	32,489	32,489	32,490	32,489	32,489
SE	Robust	Robust	Clustered	Robust	Robust	Clustered

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

probability for a shared solution of community problems. Higher conflict levels as measured by the pooled subjective answers used as a dependent variable in the "Level of Conflict"-specification, lower this probability significantly (unreported). Looking at the main sorts cultivated, again rice cultivating districts display relatively low levels of this indicator of social capital. In the second column, it becomes obvious that the effect for irrigation differs quite dramatically between the various groups, lending support to H2. In reference to landless non-farm workers, the effect of irrigation for landless farmers is even negative and close to zero for land-holding non-agriculturalists. Yet, the effect is stronger and highly significant for farmers holding land. This result persists when using district-clustered standard errors. For this indicator, only the log of income has a significant, negative influence.

The results for the indicator for membership in local organisations are presented in Table 4. Here, a somewhat contradictory result emerges. Irrigation does not have an effect on the probability for membership in a community-oriented organisation in the first specification and for none of the groups in the second, whereas rice cultivation seems to have a relatively positive influence vis-à-vis wheat on the indicator. Accounting for intra-district correlation increases the standard errors drastically. The results

Table 4: Membership & Attendance

	Local Membership			Attend Public Meeting		
	(1)	(2)	(3)	(4)	(5)	(6)
irrigation	-0.105	-0.193	-0.193	0.068	0.206	0.206
	(0.143)	(0.180)	(0.457)	(0.119)	(0.149)	(0.409)
d.rice	-0.042	0.004	0.004	-0.357	-0.321	-0.321
	(0.121)	(0.122)	(0.324)	(0.121)***	(0.121)***	(0.254)
d.wheat	-0.225	-0.224	-0.224	-0.494	-0.502	-0.502
	(0.106)**	(0.105)**	(0.246)	(0.109)***	(0.109)***	(0.195)***
d.millet	-0.156	-0.168	-0.168	-0.343	-0.382	-0.382
	(0.118)	(0.118)	(0.333)	(0.117)***	(0.117)***	(0.249)
income	0.052	0.060	0.060	0.040	0.050	0.050
	(0.011)***	(0.010)***	(0.014)***	(0.009)***	(0.009)***	(0.011)***
education	0.067	0.065	0.065	0.047	0.045	0.045
	(0.004)***	(0.004)***	(0.006)***	(0.004)***	(0.004)***	(0.005)***
ELF	0.076	0.149	0.149	-0.384	-0.306	-0.306
	(0.091)	(0.092)	(0.188)	(0.083)***	(0.083)***	(0.192)
irri*agric		0.015	0.015		-0.320	-0.320
		(0.243)	(0.396)		(0.200)	(0.457)
agric		0.128	0.128		0.370	0.370
		(0.083)	(0.124)		(0.076)***	(0.117)***
irri*land		0.252	0.252		-0.411	-0.411
		(0.282)	(0.395)		(0.228)*	(0.360)
land		0.227	0.227		0.431	0.431
		(0.083)***	(0.118)*		(0.074)***	(0.126)***
irri*agric*land		-0.188	-0.188		0.492	0.492
		(0.373)	(0.470)		(0.302)	(0.507)
agric*land		0.072	0.072		-0.148	-0.148
		(0.112)	(0.138)		(0.100)	(0.144)
N	32,439	32,439	32,439	32,445	32,444	32,444
SE	Robust	Robust	Clustered	Robust	Robust	Clustered

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

on this indicator suggests a fundamental difference between it and the ones studied before, as it is strongly correlated to income and education, but not to any agricultural indicators.

Regarding the attendance of public meetings, the evidence for an impact of irrigation is not entirely conclusive. Irrigation does not affect the indicator in general, yet it does so at a low significance level for land-owning farmers. Here, rice cultivation seems to foster contribution to social organisations, relative to the other grain sorts, yet not by a large margin. It is worth noting that in this set, non-farming landowners and landless farmers are significantly more likely to be part of organisations and attend public meetings, as indicated by the effect of the dummy-variables. In column (3), only the wheat-dummy displays a strong negative influence on the indicator among the grain dummies. Furthermore, the positive effect for the two aforementioned groups is still visible.

Table 4 presents the results for the confidence indicators. Irrigation levels in 1977 have no effect on the confidence in the local assembly when looking at the full sample, and no significant effect when differentiating between agriculturalists and non-agriculturalists. It has to be noted though that the effect for land-holding farmers is close to weak significance and points in the right direction. Individuals from districs cultivating rice in 1977 show higher confidence in local institutions compared to millet cultivation,

Table 5: Confidence in general and local institutions

	Local Confidence			General Confidence		
	(1)	(2)	(3)	(4)	(5)	(6)
irrigation	0.004	0.003	0.003	0.021	0.032	0.032
	(0.036)	(0.043)	(0.114)	(0.026)	(0.030)	(0.101)
d.rice	0.019	0.020	0.020	-0.049	-0.056	-0.056
	(0.033)	(0.033)	(0.097)	(0.024)**	(0.024)**	(0.079)
d.wheat	0.059	0.056	0.056	0.017	0.010	0.010
	(0.031)*	(0.031)*	(0.086)	(0.022)	(0.022)	(0.071)
d.millet	-0.086	-0.087	-0.087	-0.105	-0.110	-0.110
	(0.031)***	(0.031)***	(0.084)	(0.022)***	(0.022)***	(0.068)
income	0.004	0.005	0.005	0.005	0.005	0.005
	(0.003)*	(0.003)*	(0.003)	(0.002)***	(0.002)***	(0.003)**
education	0.004	0.003	0.003	0.004	0.003	0.003
	(0.001)***	(0.001)***	(0.001)**	(0.001)***	(0.001)***	(0.001)**
ELF	-0.061	-0.062	-0.062	-0.066	-0.067	-0.067
	(0.023)***	(0.023)***	(0.054)	(0.017)***	(0.017)***	(0.049)
irri*agric		-0.025	-0.025		0.122	0.122
		(0.061)	(0.109)		(0.044)***	(0.072)*
agric		-0.080	-0.080		-0.115	-0.115
		(0.023)***	(0.035)**		(0.018)***	(0.033)***
irri*land		-0.058	-0.058		-0.097	-0.097
		(0.065)	(0.090)		(0.046)**	(0.070)
land		0.008	0.008		0.013	0.013
		(0.021)	(0.028)		(0.016)	(0.023)
irri*agric*land		0.146	0.146		-0.052	-0.052
		(0.091)	(0.125)		(0.065)	(0.089)
agric*land		0.053	0.053		0.102	0.102
		(0.031)*	(0.039)		(0.023)***	(0.033)***
R2	0.07	0.07	0.07	0.05	0.06	0.06
N	32,038	32,037	32,037	32,424	32,423	32,423
SE	Robust	Robust	Clustered	Robust	Robust	Clustered

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

yet no differential effect towards wheat cultivation. Finally, the indicator for general confidence correlates negatively with rice and especially millet cultivation, and is found to be strongly influenced by income, education and ethnolinguistic fractionalization. Irrigation has a significant positive effect for landless laborers and a negative one for non-farming landowners. For land-holding farmers, the effect is not different from the reference category.

5 Discussion and Conclusion

The results provide mixed evidence for the two hypotheses on irrigation fostering cooperation. The results are relatively clear and intuitive for the conflict parameters, where irrigation increases the probability for low levels of conflict for all the groups. Regarding the conflict solution mechanism, the results strongly support H1 and H2 since the effect of irrigation is most clerly seen among land-holding farmers. The picture is less clear for the variables on participation in local institutions. In both specifications, irrigation has no visible effect for all or most of the groups, yet irrigational practice increases the probability of attendance of a public meeting for land-holding farmers significantly. Finally, irrigation does not have a clear effect on confidence in general and confidence in local institutions, even though landless farmers display greater general confidence when irrigation is practiced. The different outcomes for the various indicators align with the already mentioned results of Vanneman et al. (2006), underlining the need to look at indicators separately and the necessity to abstain from generalisations.

It clearly has to be noted though that the result depend strongly on the choice of the econometric method. Even though a number of controls (state-fixed effects, district-level controls) have been used, this does not reduce the influence of intra-district correlation on the results. Yet, the finding remains that results point in the direction of the main hypothesis for the indicators in Table 3 and for the attendance of public meetings.

Furthermore, there is both supporting and conflicting evidence for Talhelm et al. (2014)'s rice theory of culture. Whereas communities in rice cultivating districts display relatively low levels of conflict, the grain sort does not clearly influence the conflict solving strategies. Rice cultivation seems to have a relatively positive effect on membership and attendance, but seems to decrease confidence in local institutions and the likelihood for a peaceful village environment. In general, the Indian case does not seem to support the rice theory, as its two main causal factors, labor exchanges and irrigation, are, in the first case, not broadly documented and might be replaced by caste-based labor coordination, and, in the second case, are clearly not a sole attribute of rice cultivation, but also of wheat cultivation.

Regarding the persisting socio-cultural divide between East and West, this study can be informative on the role of irrigation, which could potentially also be seen as one of the fundamental differences between the two world regions. Yet, in interpreting the results, it should mostly be seen as a study of the Indian case, as Indian agriculture and the subcontinent itself is very heterogenous.

Overall, it can be noted that relations between irrigation and grain cultivation can be established for some indicators related to social capital in India, yet the evidence is not conclusive for all indicators and is not very robust to different econometric specifications. On the one hand, this clearly highlights the need to look at various dimensions of social capital (such as social norms, membership or confidence) separately and not to lump them together. On the other hand, further studies, perhaps in a more controlled environment or on the micro-level could be instructive to understand drivers of societal organisation in India. For development measures on the individual or community level to be relevant, the latter clearly has to be taken into account, which is why a deeper understanding of drivers and differences of social capital is necessary.

References

Agriculture Census of India, "Agriculture Census of India 1970-2006," http://agcensus.nic.in/document.html 2015.

Alesina, Alberto, Paola Giuliano, and Nathan Nunn, "On the Origins of Gender Roles: Women and the Plough," *National Bureau of Economic Research, Working Paper*, 2011, (17098).

Asche, Helmut, "Grundrisse der Kritik der politischen Oekonomie (Rohentwurf)," in "in," VSA-Verlag, 1978.

Bandaragoda, D. J. and Saeed ur Rehman, "Warabandi in Pakistan's canal irrigation systems: Widening gap between theory and practice," *International Irrigation Management Institute Country Paper, Pakistan*, 1995, (7).

Bardhan, Pranab, "Irrigation and Cooperation: An Empirical Analysis of 48 Irrigation Communities in South India," *Economic Development and Cultural Change*, 2000, *48* (4), 847–866.

Bohle, Hans-Georg, "Bewaesserung und Gesellschaft im Cauvery-Delta (Suedindien) - Eine geographische Untersuchung ueber historische Grundlagen und juengere Auspraegung struktureller Unterentwicklung," *Geographische Zeitschrift*, 1981, *57.*

Boserup, Ester, *Woman's Role in Economic Development*, Earthscan, 1989.

Bourdieu, Pierre, "The forms of capital," in John G. Richardson, ed., *Handbook of Theory and Reseach for the Sociology of Education*, Greenwood Press, 1986, chapter 9, pp. 241–258.

Bray, Francesca, *The Rice Economies: Technology and Development in Asian Societies*, University of California Press, 1994.

Bros, Catherine and Vani K Borooah, "Confidence in Public Bodies, and Electoral Participation in India," *European Journal of Development Research*, 2013, *25* (4), 557–583.

Cohen, Dov, Richard E. Nisbett, Brian F. Bowdle, and Norbert Schwarz, "Insult, aggression, and the southern culture of honor: An 'experimental ethnography'.," *Journal of Personality and Social Psychology*, 1996, *70* (5), 945–960.

Deccan Chronicle, "Narendra Modi's "rurban" way for agriculture," June 12, 2014. last visited on 30.7.2014.

Desai, Sonalde, Amaresh Dubey, B.L. Joshi, Mitali Sen, Abusaleh Shariff, and Reeve D. Vanneman, "India Human Development Survey: Design and Data Quality," Technical Paper 1, University of Maryland 2009.

Gneezy, Uri, Andreas Leibbrandt, and John A. List, "Ode to the sea: Workplace organisations and norms of cooperation," *Economic Journal*, forthcoming.

Gorodnichenko, Yuriy and Gerard Roland, "Individualism, innovation, and long-run growth," *Proceedings of the National Academy of Sciences*, 2011, *108* (S4), 21316–21319.

Government of India, "Census of India," http://www.censusindia.gov.in 2011.

Greif, Avner, "Contract Enforceability and Economic Institutions in Early Trade: The Maghribi Traders' Coalition," *American Economic Review*, 1993, *83* (3), 525–548.

Grist, Donald H., *Rice*, Longman, 1975.

Grosjean, Pauline, "A history of Violence: The culture of honor and homicide in the US South," *Journal of the European Economic Assocation*, October 2014, *12* (5), 1285–1316.

Guiso, Luigi, Paola Sapienza, and Luigi Zingales, "The role of social capital in financial development," *American Economic Review*, June 2004, *94* (3), 526–556.

Henrich, Joseph, *Foundations of human socsocial - economic experiments and ethnographic evidence from fifteen small-scale societies*, 1 ed., Oxford Univ Press, 2004.

_ , Robert Boyd, Samuel Bowles, Colin Camerer, Ernst Fehr, Herbert Gintis, and Richard McElreath, "In Search of Homo Economicus: Behavioral Experiments in 15 Small-Scale Societies," *American Economic Review*, 2001, *91*, 73–78.

Hofstede, Geert, "Research and VSM," http://geerthofstede.eu/research–vsm 2015.

ICRISAT, "VDSA Database," http://vdsa.icrisat.ac.in/vdsa-database.htm 2013.

Knack, Stephen and Philipp Keefer, "Does Social Capital have an economic payoff? A cross-country investigation," *The Quarterly Journal of Economics*, 1997, *112* (4), 1251–88.

Mauro, Paulo, "Corruption and Growth," *The Quarterly Journal of Economics*, August 1995, *110* (3), 681–712.

Nakamura, Hisashi, "Village Community and Paddy Agriculture in South India," *The Developing Economies*, 1972, *10* (2), 141–165.

Narayan, Deepa and Lant Pritchett, "Cents and Sociability: Household Income and Social Capital in Rural Tanzania," *Economic Development and Cultural Change*, 1999, *47* (4), 871–897.

Putnam, Robert D., *Making Democracy Work*, Princeton University Press, 1993.

Raghuvanshi, C. S., *Management and Organisation of Irrigation System*, Atlantic Publishers and Distributors, 1995.

Rao, Mohan J., "Agrarian power and unfree labour," *Journal of Peasant Studies*, 1999, *26* (2-3), 242–262.

Rao, P. Parthasarathy, E. Jagadeesh, and L. M. Pandey, *District Level Database Documentation* ICRISAT 2012.

Rehm, Sigmund, *Handbuch der Landwirtschaft und Ern"ahrung in den Entwicklungsl"andern*, 2 ed., Ulmer, 1989.

Sajor, Edsel E., "Are they Incompatible? Modern Farming and Non-Market Labour in the Northern Philippine Uplands," in Ratna Saipuri Becky Elmhirst, ed., *Labour in Southeast Asia: Local Processes in a Globalised World*, Routledge, 2004, chapter 6, pp. 157–187.

Sayre, K.D., "Management of irrigated wheat," in B.C. Curtis, S. Rajaram, and H. Gomez Macpherson, eds., *Bread Wheat - Improvement and Production*, FAO Plant Production and Protection Series, Food and agricultural organisation, 2002.

Story, William T., "Social Capital and the utilization of maternal and child health services in India: A multilevel analysis," *Health & Place*, 2014, *28*, 73–84.

Tabellini, Guido, "Culture and institutions: Economic development in the regions of Europe," *Journal of the European Economic Assocation*, June 2010, *8* (4), 677–716.

Talhelm, Thomas, X. Zhang, Shige Oishi, C. Shimin, D. Duan, X. Lan, and S. Kitayama, "Large-Scale Psychological Differences Within China Explained by Rice Versus Wheat Agriculture," *Science*, 2014, *344* (6184), 603–608.

The Hindu, "Modi announces new irrigation scheme," *The Hindu*, August 20th, 2014.

The Times of India, "Govt to scale up 'rurban' infrastructure," June 10, 2014.

Tsusaka, Takuji W., Kei Kajisa, Valerien O. Pede, and Keitaro Aoyagi, "Neighborhood Effects and Social Behavior: The Case of Irrigated and Rainfed Farmers in Bohol, The Phillipines," *Journal of Economic Behavior & Organization*, 2015, in press.

Vanneman, Reeve D., James Noon, and Sonalde Desai, "Social Capital in India: Networks, Organizations, and Confidence," *India Human Development Survey, Working Paper*, 2006, *4.*

Vikram, Kriti, Reeve Vanneman, and Sonalde Desai, "Linkages between maternal education and childhood immunization in India," *Social Science & Medicine*, 2012, *75* (2), 331–339.

Wittfogel, Karl A., *Oriental Despotism - a comparative study of total power*, Yale University Press, 1957.

Wong, Diana, *Peasants in the Making: Malaysia's Green Revolution*, Institute of Southeast Asian Studies, 1987.

World Bank, *Mind, Society and Behavior - World Development Report 2015*, World Bank Group, 2015.

Zak, Paul J. and Stephen Knack, "Trust and Growth," *The Economic Journal*, Apr 2001, *111* (470), 295–321.

Table 6: Descriptive Statistics

	Full sample				Agriculturalists		Non-Agriculturalists		Landowner		Landless	
Variable	Obs	Mean	Std. Dev.	Range	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean
Dependent Variables												
Conflict Solution	32525	0.581	0.321	[0;1]	14492	0.560	18033	0.597	15661	0.591	16863	0.571
Local Conflict	32525	2.393	0.541	[1;3]	14492	2.389	18033	2.396	15661	2.36	16863	2.423
Membership	32474	0.231	0.422	[0;1]	14464	0.260	18010	0.208	15636	0.258	16838	0.206
Attend Public Meeting	32480	0.301	0.459	[0;1]	14471	0.368	18009	0.247	15643	0.383	16836	0.225
General Confidence	32525	-0.01	0.538	[-1.39;2.66]	14469	-0.023	17990	0.000	15635	0.034	16823	-0.011
Local Confidence	32073	2.163	0.722	[1;3]	14317	2.190	17756	2.141	15479	2.201	16593	2.126
Explanatory Variables												
irrigation	32525	0.266	0.214	[0;0.94]	14492	0.249	18033	0.279	15661	0.238	16863	0.292
dummy_rice	32525	0.357	0.479	[0;1]	14492	0.328	18033	0.381	15661	0.336	16863	0.377
dummy_wheat	32525	0.207	0.405	[0;1]	14492	0.192	18033	0.219	15661	0.218	16863	0.200
dummy_millet	32525	0.400	0.490	[0;1]	14492	0.498	18033	0.351	15661	0.391	16863	0.407

Annex

Figure 2: Rice Cultivation as Share of Total Area under Grain Cultivation

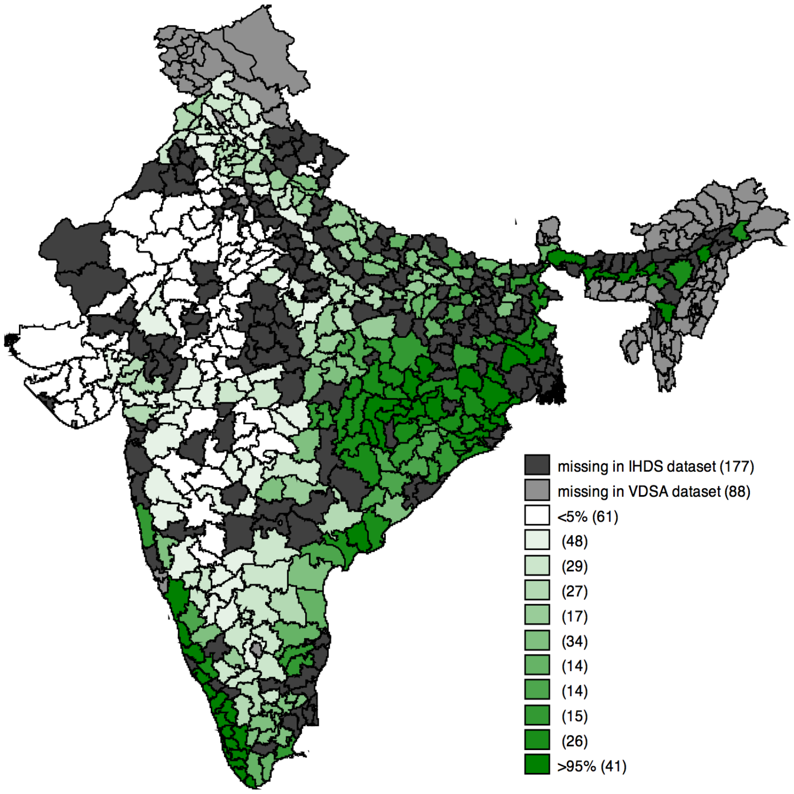


Figure 3: Wheat Cultivation as Share of Total Area under Grain Cultivation

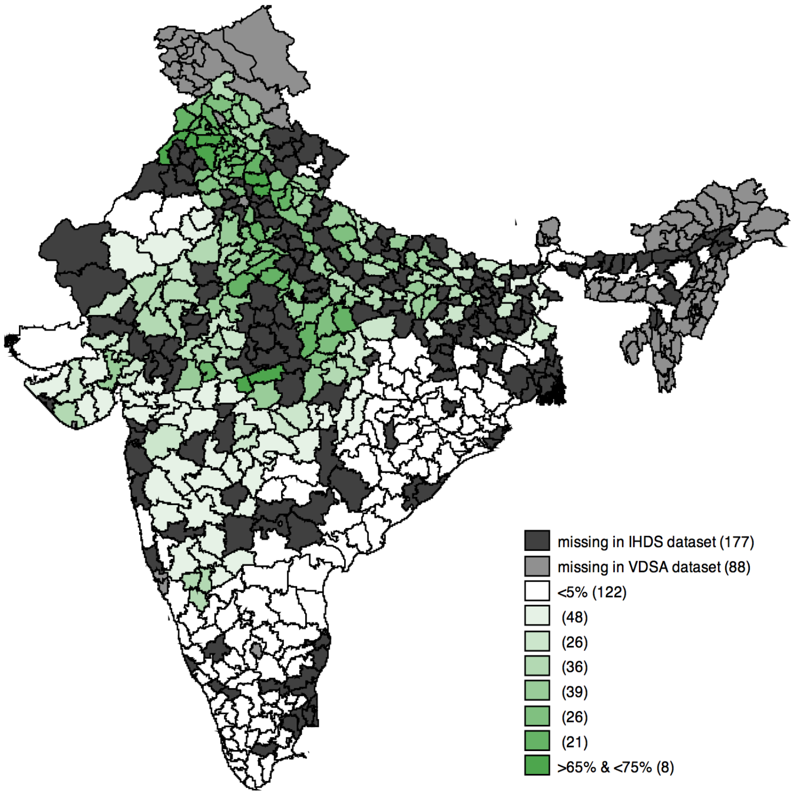


Figure 4: Millet Cultivation as Share of Total Area under Grain Cultivation

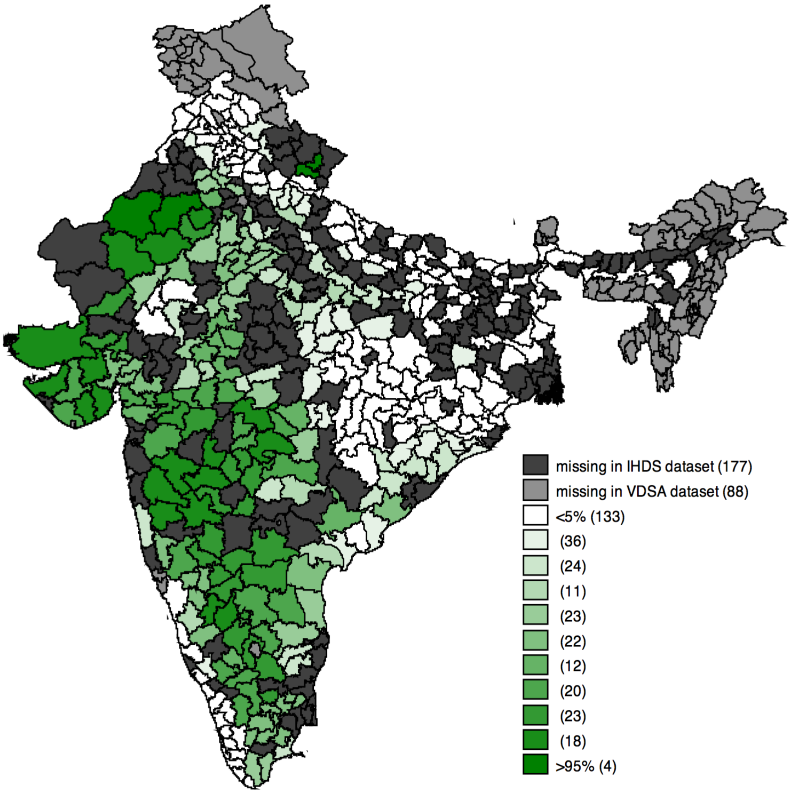


Figure 5: Irrigated Area as Share of Total Area under Cultivation

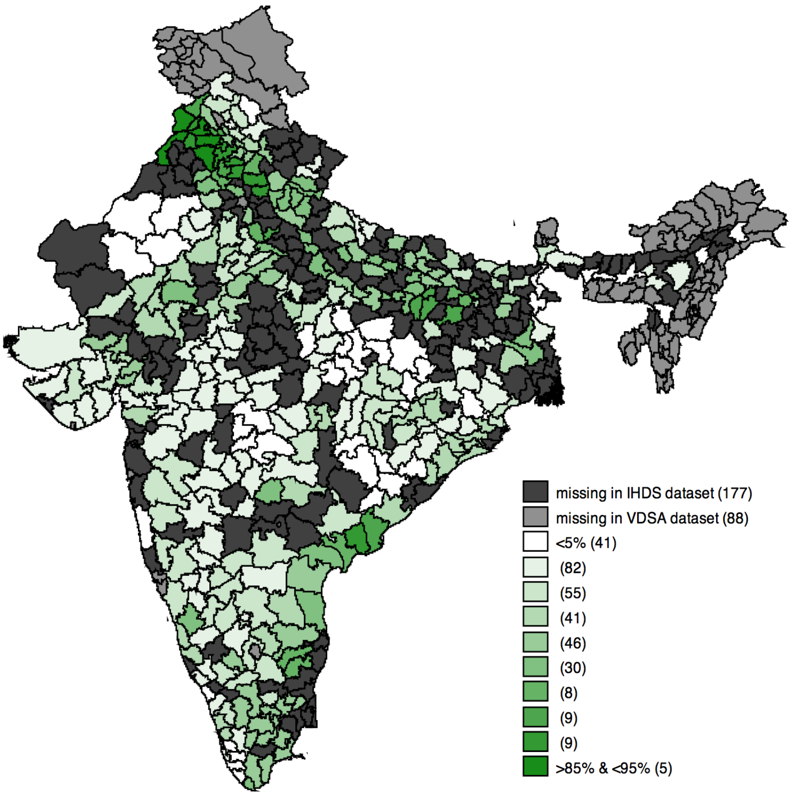


Table 7: Indicators of social capital

Indicator	Original Question	Coding
Level of Conflict	In this village/ neighborhood, do people generally get along with each other or is there some conflict or a lot of conflict?	1= A lot; 2=Some; 3=Get Along
Conflict Solution	In some communities, when there is a water supply problem, people bond together to solve the problem. In other communities, people take care of their own families individually. What is your community like?	0=Each family individually; 1=Bond together
Local Membership	Does anybody in the household belong to [any of] a (1) self help group, (2) credit or savings group, (3) development group of NGO, (4) agricultural, milk, or other co-operative?	0=No; 1=Yes
Attend Public Meeting	Have you or anyone in the household attended a public meeting called by the village panchayat/nagarpalika/ward committee in the last year?	0=No; 1= Yes
Local Confidence	Confidence in village panchayats / nagarpalika to implement public projects	1=Hardly any; 2=Only some; 3=A great deal
General Confidence	(1) Confidence in politicians to fulfill promises; (2) Confidence in military to defend the country; (3) Confidence in the police to enforce the law; (4) Confidence in the state goverment to look after the people; (5) Confidence in newspapers to print the truth; (6) Confidence in village panchayats / nagarpalika to implement public projects; (7) Confidence in schools to provide good education; (8) Confidence in hospitals and doctors to provide good treatment; (9) Confident in courts to meet out justice; (10) Confidence in banks to keep money safe	1=Hardly any; 2=Only some; 3=A great deal